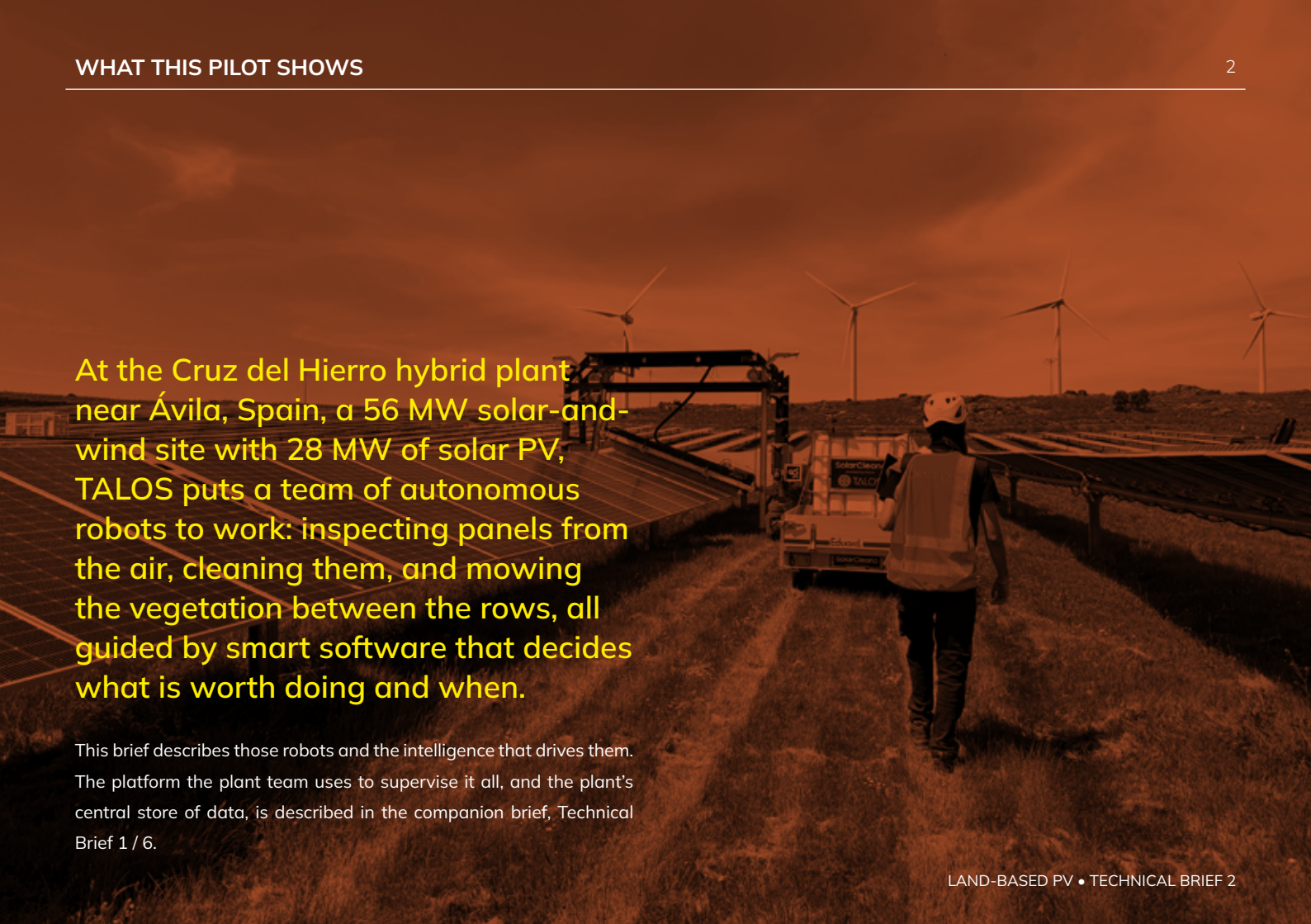


Land-Based PV



The Robots and the Intelligence Behind Them

The self-driving machines that clean, mow and inspect the plant, and the smart tools that decide what needs doing and when.

A person wearing a white helmet and a high-visibility safety vest is walking away from the camera down a dirt path in a solar field. In the background, there are several rows of solar panels and several wind turbines under a cloudy sky. A small white vehicle with 'SolarClean' and 'TALOS' branding is visible in the distance.

At the Cruz del Hierro hybrid plant near Ávila, Spain, a 56 MW solar-and-wind site with 28 MW of solar PV, TALOS puts a team of autonomous robots to work: inspecting panels from the air, cleaning them, and mowing the vegetation between the rows, all guided by smart software that decides what is worth doing and when.

This brief describes those robots and the intelligence that drives them. The platform the plant team uses to supervise it all, and the plant's central store of data, is described in the companion brief, Technical Brief 1 / 6.

Normally, plant data sits in separate tools, faults are found by hand, and cleaning is booked on a fixed calendar.

TALOS builds a **live digital model of the plant**, spots underperformance automatically, works out the most worthwhile jobs, and **sends** autonomous robots to carry them out, with **no** one needing to be in the field. Across the project, this is expected to **improve resource efficiency** in maintenance work by around 10%, cut lost production by up to 10%, and save around 35% of the water used in cleaning.

This brief clearly separates the smart tools that analyse the plant, from the six robotic solutions that do the work. The features of the digital platform the team uses, and the central data store, are covered in Technical Brief 1 / 6.

Three connected tools turn plant data into a shortlist of worthwhile jobs.



A LIVE DIGITAL MODEL OF THE PLANT

A constantly-updated digital model (a 'digital twin') mirrors how the plant should be performing. By comparing this with the real readings, it helps pinpoint where output is lower than expected.



AUTOMATIC FAULT AND UNDERPERFORMANCE DETECTION

Software watches the plant's data and flags anomalies (at panel, string and inverter level) together with an estimate of how much energy each one is costing. It also estimates how much dirt has built up, so cleaning can be timed well.



WORTHWHILE-JOB SUGGESTIONS

Drawing on all of the above, the system proposes cleaning, mowing and inspection jobs and ranks them by the value they bring — the energy recovered against the cost of the work — before they reach the plant team for approval.

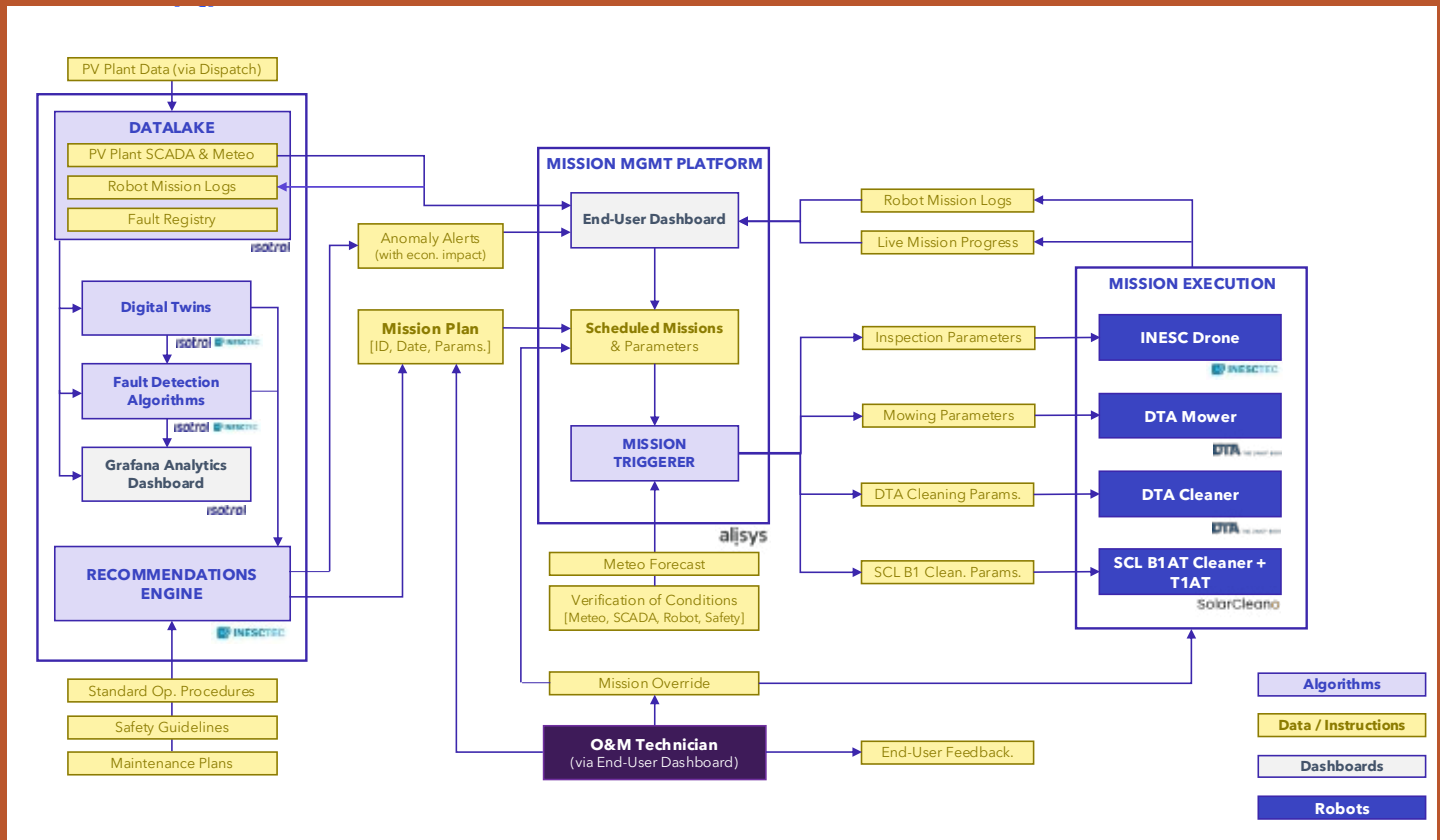


Figure 1. From plant data to robot missions: how the smart tools and the robots work together in the Land-Based PV pilot.

Source: TALOS project.

The pilot uses six robotic solutions: three inspection drones, two cleaning robots and one mower.



INSPECTION DRONES

Three drones inspect the panels from the air using ordinary and **heat-sensing (thermal) cameras**, which reveal problems the eye cannot see: hot spots, soiling and bird-droppings. They fly **pre-planned routes** on their own (up to two inspecting at the same time), land with centimetre-level accuracy, and deliver their images and **a map of located faults** automatically to the user platform. One of the drones can be based in a small automated 'garage' on site that launches and recovers it without anyone present.



THE CLEANING-AND-MOWING GROUND VEHICLE

A single self-driving ground vehicle handles both jobs by reconfiguring itself: **a cleaning setup** (with a sensor-guided cleaning arm and a water tank) and **a mowing setup** (with a retractable cutting-chain system). It swaps setup and **recharges automatically**, and finds its way using satellite positioning and on-board sensors, with emergency stops, bumpers and obstacle sensors for safety.



THE LARGE-SCALE CLEANING ROBOT

A second cleaning solution is built for large plants: **a cleaning robot leads along the rows while a support unit follows behind**, carrying the water it needs (up to 1,000 litres) and keeping pace automatically. Solar panels mounted on the system let it recharge while it works, extending the operating time in the field, and sensors keep the brush aligned and protect the panels.

A typical cleaning job follows a simple chain:

- 1** The digital model sets the expected performance.
- 2** The detection tools identify where output is dropping and how dirty the panels are.
- 3** The system schedules a cleaning job that gives the best return.
- 4** The proposed mission awaits approval from the plant team before it can start autonomously.
- 5** When the time comes, the platform first checks the weather is suitable and then sends the robot out.
- 6** The plant team can watch progress live and pause or stop the job at any moment.
- 7** When it finishes, a short report, which rows were cleaned and whether it succeeded, is saved back to the platform.

THE ROBOTS AT A GLANCE

ROBOT	WHAT IT DOES
Inspection drones (×3)	Fly the plant and photograph panels with normal and thermal cameras to find faults; up to two at a time.
Cleaning & mowing vehicle	One ground vehicle that reconfigures itself — cleans the panels or mows the rows between panels.
Large-scale cleaning robot	A cleaning robot with a following water-carrier for continuous cleaning on big plants.

This part of TALOS is aimed at plant operators, robotics providers and technology partners who want to combine smart analysis with self-driving machines.

The benefits it targets are:

Lower water use in cleaning (around 35% saving targeted), thanks to well-timed, optimised jobs.

Energy recovered by tackling dirt and faults before they add up.

Faster, fuller inspection coverage than manual, sampling-based checks at lower cost per inspection.

Less time spent by people in hot, hazardous or hard-to-reach areas.

Recommendations from the TALOS Land-PV experience

- **Supervise autonomy, especially during early roll-out:** keep operator validation of scheduling and execution to reduce risk and build confidence.
- **Plan the logistics that make autonomy work:** robots need upkeep and support such as water availability and charging to run reliably.
- **Adapt roles, procedures and training:** teams need updated safety rules and new skills to supervise the robots effectively.
- **Refine the intelligence over time:** new or improved algorithms can be added to automate further O&M tasks.

GLOSSARY	
Digital twin	A live software model of the plant used to see how it should be performing.
Thermal camera	A camera that sees heat, revealing hot spots and hidden panel faults.
Drone (UAV)	A small uncrewed aircraft used to inspect the panels from the air.
Ground vehicle (AGV)	A self-driving machine that cleans or mows on the ground.
Soiling	Dust, dirt or droppings on the panels that reduce their output.

PROJECT PARTNERS BEHIND THE ROBOTS AND INTELLIGENCE	
	Digital model, fault detection, job suggestions and the inspection drones.
	The cleaning-and-mowing ground vehicle.
	The large-scale cleaning robot and its water-carrier.
	The platform and data store that connect and run the fleet (see Brief 1 / 6).



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